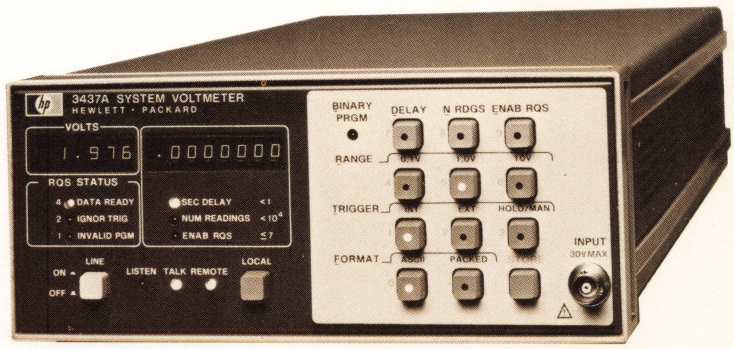
BC 579490

OPERATING MANUAL

SYSTEM VOLTMETER

3437A



HEWLETT hp PACKARD

OPERATING MANUAL

MODEL 3437A

SYSTEM VOLTMETER

Serial Numbers: 1630A00101 and greater

IMPORTANT NOTICE

This manual applies to instruments with serial numbers indicated on this page. If the instrument has been changed since this manual was printed, a yellow "Manual Change Sheet" (containing updating information) will be supplied with this manual.

WARNING

To prevent potential fire or shock hazard, do not expose equipment to rain or moisture.

Manual Part No. 03437-90012

Revision A

P.O. Box 301, Loveland, Colorado 80537 U.S.A.

Printed: December 1978

HEWLETT hp PACKARD

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this product.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment, except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. However, warranty service for products installed by -hp- and certain other products designated by -hp- will be performed at Buyer's facility at no charge within the -hp- service travel area. Outside -hp- service travel areas, warranty service will be performed at Buyer's facility only upon -hp's- prior agreement and Buyer shall pay -hp's- round trip travel expenses.

For products returned to -hp- for warranty service, Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

11/3/78

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by Service-Trained personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

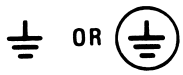
WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

General Definitions of Safety Symbols Used On Equipment

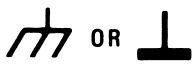
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury.

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains general information concerning the -hp- Model 3437A System DVM. Included is an instrument description, specifications, information concerning instrument and accessory information, and safety considerations.

1-3. DESCRIPTION.

1-4. The Model 3437A is a Microprocessor controlled 3½ digit, successive approximation system voltmeter, capable of sampling voltages at rates up to 5700 samples per second.

1-5. Chassis isolated input terminals, a wideband input amplifier, auto-zero, auto-polarity, sample and hold, and 100% overrange on each of the input voltage ranges (.1 volt, 1 volt, and 10 volts) provide floating measurement capability (± 20 V) over the frequency range of DC through 1.0 MHz.

1-6. Hewlett-Packard Interface Bus is standard. All front panel functions are programmable. The output data format is selectable between an ASCII (8 byte) and Packed (2 byte) format. The packed data format allows the controller additional data storage as well as allowing the input voltage to be sampled at rates up to 5700 samples per second.

1-7. The 3437A digital delay logic is capable of delaying an external trigger from 0 to 1 second (100 ns steps), and of generating up to 9999 triggers (for each trigger received) at rates of 1 Hz through 5700 Hz. The internally generated triggers provide a burst sampling capability (up to 9999 samples) at a maximum rate of 5700 sampled per second. Figures 1-1 and 1-2 illustrate the delayed measurement and burst sampling capabilites of the 3437A.

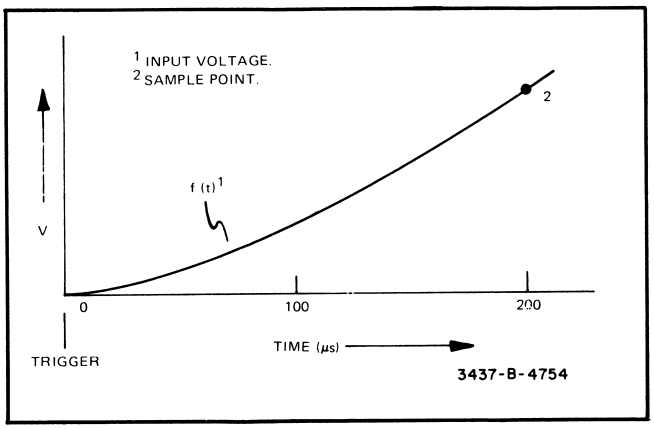


Figure 1-1. NRDGS = 1 DELAY = 200 µs.

1-8. (Figure 1-1) 200 µs after being triggered, the 3437A will sample and (after conversion) display the instantaneous value of the input voltage. If the 3437A is addressed to talk, the sampled input voltage will be output onto the HP-IB.

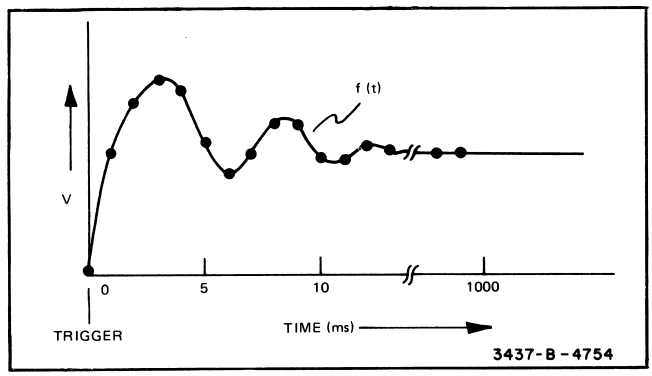


Figure 1-2. NRDGS = 1000 DELAY = 1 ms.

1-9. (Figure 1-2) When triggered, the 3437A will sample the input voltage 1000 times at 1 ms intervals. Between samples, the instantaneous value of the sampled input voltage is converted and output onto the HP-IB.

1-10. The Binary Program mode provides a means of programming the 3437A using an abreviated program code. When interrogated in the Binary Program mode. The 3437A responds by writing 7 bytes (completely describing the programmed state of the instrument) onto the HP-IB. The controller can use these 7 bytes as an abreviated program code to reprogram the 3437A to its previous configuration.

1-11. Model 3437A applications include:

a. Fast multipoint data-acquisition.

b. Repetitive-waveform analysis.

c. Low frequency transient characterization.

d. Low frequency True RMS measurements.

1-12. SPECIFICATIONS.

1-13. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Any change in the specifications due to manufacturing, design, or traceability to the U.S. National Bureau of Standards will be covered by revised pages, a change sheet, or both, to this manual. Addi-

Table 1-1. Specifications.

VOLTAGE MEASUREMENT CHARACTERISTICS.

Range	Bandwidth (3dB)		Display*
10 Volt	1.0 MHz	± 19.98 (max)	± 99.99 (ovrld)
1 Volt	1.1 MHz	± 1.998	± 9.999
.1 Volt	40 kHz	± .1998	± .9999

Static Accuracy (90 days, 23°C ± 5°C)

10 Volt Range	± 0.05% of Reading	± 1.6 Digits
1 Volt Range	± 0.03% of Reading	± 1.6 Digits
.1 Volt Range	± 0.06% of Reading	± 1.8 Digits

Static Accuracy (1 year, 23°C ± 5°C)

10 Volt Range	± 0.05% of Reading	± 2.0 Digits
1 Volt Range	± 0.03% of Reading	± 2.0 Digits
.1 Volt Range	± 0.06% of Reading	± 2.2 Digits

Static Accuracy Temperature Coefficient (0°C to 50°C)
± 0.002% reading/°C ± 0.05 digits/°C

Dynamic Accuracy

Range	Step Input	mV within Final Value	Time
10 Volt	10 V	± 200 mV	700 ns
10 Volt	10 V	± 30 mV	7.5 µs
1 Volt	1 V	± 20 mV	700 ns
1 Volt	1 V	± 3 mV	1.5 µs
.1 Volt	.1 V	± 200 µV	25 µs

DELAY CHARACTERISTICS.

Delay
For NRDGS equal to 0 or 1
0 to .9999999 sec in 100 ns steps

For NRDGS > 1

Data Format	Delay between readings
ASCII	277.8 µs to .9999999 sec
Packed	175.4 µs to .9999999 sec

Offset (actual delay with 0 delay programmed)
100 ns ± 25 ns

Accuracy
± 0.008% Delay + Delay offset

Repeatability (Jitter)
For NRDGS equal to 0 or 1

Delay	Jitter
0 or 100 ns	2 ns
200 ns to 50 ms	10 ns + .002% of Delay
> 50 ms	110 ns

NUMBER OF READINGS. (For each trigger received.)

From 0 to 9999

INPUT CHARACTERISTICS.

Input Impedance

Range	Impedance	
10 Volt	1 MΩ (± 20%)	< 75 pF
1 Volt	> 10^8 Ω	< 75 pF
.1 Volt	> 10^8 Ω	< 75 pF

Maximum Input Voltage (All ranges)

HI to LO	< ± 30 V Peak
LO to CHASSIS	< ± 42 V Peak

PROGRAMMABILITY.

(In accordance with IEEE - 488-1975)

AH1	Acceptor	PPØ	Parallel Poll
CØ	Controller	RL1	Remote/Local
DC1	Device Clear	SR1	Service Request
DT1	Device Trigger	SH1	Source
L4	Listener	T5	Talker

COMMON MODE REJECTION RATIO.

≥ 75 dB (1 kΩ unbalance in low input lead at 60 Hz)

*Display will indicate overload if input is unterminated (.1 volt range).

Table 1-2. Supplemental Characteristics.

MAXIMUM READING RATE.[1]

ASCII	3600 Readings per second
Packed	5700 Readings per second

[1]Actual reading rate is given by:

ASCII $\dfrac{3600 \times 7 \text{ Byte Listen Rate}}{3600 + 7 \text{ Byte Listen Rate}}$

Packed $\dfrac{5700 \times 2 \text{ Byte Listen Rate}}{5700 + 2 \text{ Byte Listen Rate}}$

Where Listen Rate = Data acceptance rate of listener

GENERAL.

Power Requirements

100 V, 120 V, 220 V, 240 V (+ 5% −10%, 48–440 Hz)
≤ 42 VA

Operating Temperature

0°C to 50°C

Storage Temperature

−40°C to 75°C

Humidity Range

< 95% RH (0°C to 40°C)

Dimensions

212.7 mm wide x 88.9 mm high x 527.1 mm deep

Weight

Net	5.6 kg
Shipping	7.6 kg

Model Number and Name

3437A System Voltmeter

tional information describing the operating characteristics (Table 1-2) are not specifications but are supplemental information for the user.

1-14. OPTIONS.

1-15. The following options are available for the -hp- Model 3437A System Voltmeter:

Option	-hp- Part Number	Description
907	5061-0088	Front Handle Kit
908	5061-0072	Cabinet Assembly
909	5061-0075	Cabinet Assembly

1-16. ACCESSORIES.

1-17. The following accessories are available and can be ordered from your nearest -hp- Sales and Service Office:

1. DSA Test ROM -hp- 34115A
2. Performance Test Source Interface -hp- 34114A
3. Performance Test Trigger Interface -hp- 34113A

1-18. SAFETY CONSIDERATIONS.

1-19. If, to preserve the apparatus from damage, it is necessary for the user to refer to the instruction manual, the apparatus will be marked with the symbol ⚠.

1-20. INSTRUMENT IDENTIFICATION.

1-21. A three-section serial number (XXXXAXXXXX) is used to identify the Model 3437A. Figure 1-3 illustrates the meaning of the three parts of the number.

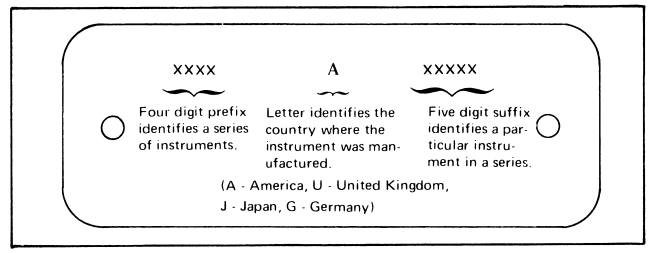


Figure 1-3. Instrument Serial Number.

Table 1-3. Message Transfer Rates (Listen).

Listen	Handshake (μs/Byte)[A]
Commands (ATN True)	
Addressed to Listen (ATL)	58
Addressed to Talk (ATT)	38
Group Execute Trigger (GET)	160
Local Lockout (LLO)	37
Selected Device Clear (SDC)	124
Serial Poll Enable (SPE)	35
Serial Poll Disable (SPD)	36
Unlisten (UNL)	36
Untalk (UNT)	36
Program Code (ATN False)	
Delay	100
"."	92
0	64
1	69
2	74
3	79
4	84
5	89
6	94
Store	176
NRDGS	112
1	94
2	68
3	68
4	68
Store	112
Enab RQS	108
7	59
Store	90

Listen	Handshake (μs/Byte)[A]
Program Code (ATN False) Cont'd	
Range 1	56 88
Range 2	56 89
Range 3	56 90
Trigger 1	56 97
Trigger 2	56 98
Trigger 3[B]	56 90
Trigger 3[C]	56 74
Format 1	56 98
Format 2	56 99
Binary Prgm	83
1st Byte	95
2nd Byte	78
3rd Byte	66
4th Byte	75
5th Byte	42
6th Byte	42
7th Byte	140

[A] Typical

[B] Initial

[C] Subsequent—maximum rate (due to conversion time)≅240 μs.

Table 1-4. Message Transfer Rates (Talk).

Talk	Handshake (μs/Byte)[A]
Data Formats (ATN False)	
ASCII	22 μs
Packed	20 μs

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions pertaining to initial instrument set-up. Included are initial inspection procedures, power and grounding requirements, environmental information, bench and rack mounting instructions, a description of interface connectors, and repackaging instructions.

2-3. INITIAL INSPECTION.

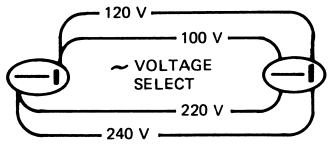
2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage that might have occurred in transit, and the electrical performance should be tested using the performance tests outlined in Section V. If there is damage or deficiency, refer to the warranty inside the front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. This instrument can be operated from ac line voltages of 100 V, 120 V, 220 V, 240 V, at corresponding line frequencies of 48 through 440 Hz.

CAUTION

Verify that the 110 V/220 V Line Voltage Selection switch, (Figure 2-1) located on the rear panel of Model 3437A, is set to the ac source voltage to be used before inserting the power cord and turning the instrument on. Also insure that the proper fuse is installed.



LINE VOLTAGE (VOLTS)	OPERATING RANGE (VOLTS)	FUSE (mA)
100	90–105	500
120	108–126	500
220	198–231	250
240	216–252	250

3437-B-4755

[1]SELECTED FOR 120V.

Figure 2-1. Line Voltage Selection.

2-7. Power Cords and Receptacles.

2-8. Figure 2-2 illustrates the various -hp- power cord configurations. If the appropriate power cord is not included with the instrument, notify the nearest -hp- Sales and Service Office and a replacement cord will be provided.

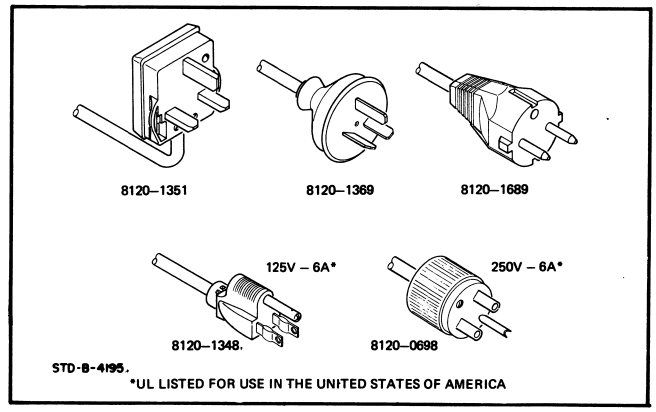


Figure 2-2. -hp- Power Cords.

2-9. Grounding Requirements.

2-10. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Model 3437A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable is the ground wire.

2-11. To preserve the protection feature when operating from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to power line ground.

2-12. ENVIRONMENTAL REQUIREMENTS.

2-13. The 3437A should not be operated where the ambient temperature exceeds 0°C to 50°C or stored where the ambient temperature exceeds - 40°C to + 75°C.

2-14. Humidity.

2-15. The instrument may be operated in environments with relative humidity of up to 95%. However, the instrument must be protected from temperature extremes which cause condensation within the instrument.

2-16. Altitude.

2-17. The instrument may be operated at altitudes up to 4573 meters (15,000 feet).

WARNING

To prevent potential electrical or fire hazard, do not expose equipment to rain or moisture.

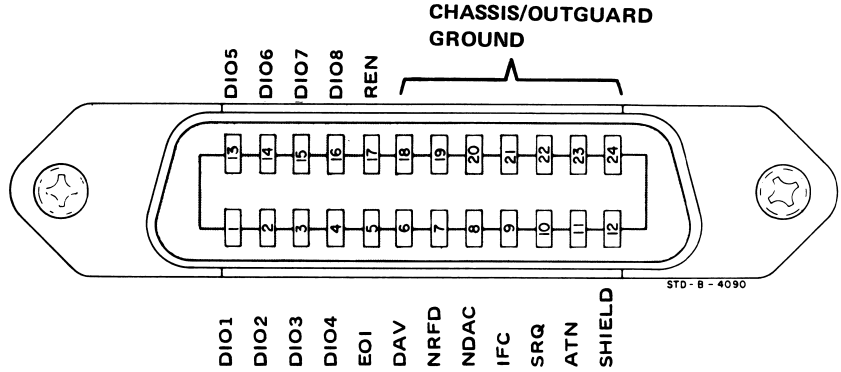
2-18. INSTRUMENT MOUNTING.

2-19. The Model 3437A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument. The front of the instrument may be elevated for convenience of operating and viewing by extending the tilt stand. The plastic feet are shaped to permit placing the instrument on top of other half-module Hewlett-Packard instruments.

2-20. Rack Mounting.

2-21. The Model 3437A is housed in a -hp- standard (½

HP-IB CONNECTOR J12



Mating Connector:

-hp- Part No. 1251-0293
Amphenol No. 57—30240

Mating Cables:

10631A	3 ft.
10631B	6 ft.
10631C	12 ft.

DIO 1-8 (Data Input/Output)
Mnemonic referring to the eight "Data Input/Output" lines. The DIO lines transfer messages in a byte-serial, bit parallel manner.

EOI (End or Identify)
Mnemonic referring to the "End or Identify" control line. EOI is used by a device to indicate the end of a multiple-byte transfer.

DAV (Data Valid)
Mnemonic referring to the "Data Valid" control line. DAV is used to coordinate the "handshake" sequence. The DAV line is controlled by the source (talker). When DAV is true, data on the DIO lines is considered valid.

NRFD (Not Ready For Data)
Mnemonic referring to the "Ready For Data" control line. NRFD is used to coordinate the "handshake" sequence. The NRFD line is controlled by the acceptor (listener). When NRFD is true, the acceptor indicates to the source that he is ready to accept data.

NDAC (Data Not Accepted)
Mnemonic referring to the "Data Accepted" control line. NDAC is used to coordinate the "handshake" sequence. The NDAC line is controlled by the acceptor (listener). When NDAC is true, the acceptor indicates to the source that the data on the DIO lines has been accepted.

IFC (Interface Clear)
Mnemonic referring to the "Interface Clear" control line. IFC is used to place the HP-IB system in a known quiescent state. The IFC line is controlled by the system controller.

SRQ (Service Request)
Mnemonic referring to the "Service Request" control line. SRQ is used (by any device having service request capability) to indicate to the system controller that the device requires service. The controller responds by polling the devices to determine which device requested service.

ATN (Attention)
Mnemonic referring to the "Attention" control line. The state of the ATN line determines whether the HP-IB is in the "Command mode" (ATN true) or the "Data mode" (ATN false). When ATN is true, all devices must listen to the data lines, and when ATN is false, only devices that have been addressed will actively transfer data.

REN (Remote Enable)
Mnemonic referring to the "Remote Enable" control line. REN is used in conjunction with listen addresses (DIO 1-8) to select either local or remote control of each device.

For further information concerning the HP-IB, refer to "Hewlett-Packard Interface, A Compendium of Technical Articles" -hp- publications No. 5952-2472.

Figure 2-3. Hewlett-Packard Interface Bus Connector.

module) System II enclosure. Refer to the -hp- catalog for rack mounting accessories.

2-22. Interface Connectors.

2-23. Input. The voltage to be measured is applied to either the front or rear panel mounted (parallel connected) triax connector labeled INPUT.

2-24. Ext Trig and Delay Out. A standard (negative edge) TTL input applied to the rear panel mounted BNC connector labeled EXT TRIG causes the instrument to initiate one or more measurements and provide one or more corresponding delayed triggers at the rear panel mounted BNC connector labeled DELAY OUT.

2-25. Hewlett-Packard Interface Bus (HP-IB). Figure 2-3 illustrates the rear panel HP-IB connector, along with a brief description of each signal line.

2-26. Interface Cable Length. The maximum accumulative length of an HP-IB cable in any system must not exceed more than 2 meters of cable per device (up to 15 devices) or 20 meters, which ever is less.

2-27. REPACKAGING FOR SHIPMENT.

2-28. The following is a general guide for repackaging the instrument for shipment. If the original container is available, place the instrument in the container with appropriate packing material and seal with strong tape or metal bands. If the original container is not available, proceed as follows:

a. Wrap the instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of the instrument and protect panel face with cardboard strips or plastic foam.

c. Place the instrument and inner container in a heavy carton and seal with strong tape or metal bands.

d. Mark shipping container "DELICATE INSTRUMENT." "FRAGILE." etc.

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and full serial number. If you have any questions, contact your nearest -hp- Sales and Service Office.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains complete operating instructions (both bench and system) for the Model 3437A Systems Voltmeter. Included is a description of the front and rear panel controls and indicators, programming instructions, and application examples.

3-3. Controls and Indicators.

3-4. Figure 3-1 identifies the 3437A displays, annunciators, controls, and connectors. The identification of each item is keyed to the drawing within the figure.

3-5. Front Panel Description.

3-6. KEYBOARD. The 3437A keyboard functions in two modes:

a. Key per function.

b. Numeric entry.

3-7. Key Per Function. The Key Per Function mode (each key representing instrument functions) occurs when the instrument is turned on.

3-8. Numeric Entry. The Numeric Entry mode (annunciated by blinking DELAY, NRDGS, or ENAB RQS annunciators) is a subset of the Key Per Function mode, and occurs when either the DELAY (7) N RDGS (8) ENAB RQS (9) keys are pressed while the keyboard is in the Key Per Function mode. Subsequent entries (displayed by the numeric entry display) correspond to the blue labeled numeric symbols 0-9 and decimal point . The Numeric Entry mode is terminated when STORE is pressed.

3-9. VOLTS DISPLAY. Displays the sign and magnitude of the sampled input voltage ("+" is implied). The overload indication is ± 99.99 (Decimal point position corresponds to voltage range selected).

3-10. NUMERIC ENTRY DISPLAY. The contents of the numeric entry display are annunciated directly below the display.

3-11. RQS STATUS. The RQS STATUS annunciators annunciate the instrument status.

3-12. Data Ready. The DATA READY annunciator notifies the operator that the sampled input voltage has been converted, displayed, and is ready to be output onto the HP-IB. The DATA READY annunciator remains on until the measurement data has been output onto the HP-IB, or until a new function is programmed.

3-13. Ignore Trig. The IGNORE TRIG annunciator notifies the operator that a second trigger occured prior to completion of the measurement sequence/data transfer initiated by the first trigger, and that the second trigger was ignored. The IGNORE TRIG annunciator remains on until a new function is programmed.

3-14. Invalid Prgm. The INVALID PRGM annunciator notifies the operator that an invalid program condition has occurred. The annunciator becomes illuminated during the Remote and Local modes of operation, for the following reasons:

LOCAL:

a. DELAY (0–.9999999). The first entry into the delay field must be a decimal point. Any entry other than a decimal point (leading zeros ignored) results in an invalid program condition. When this occurs, the last valid delay entry is stored and the numeric entry mode is terminated. The INVALID PGM annunciator remains on until the key causing the invalid entry is released.

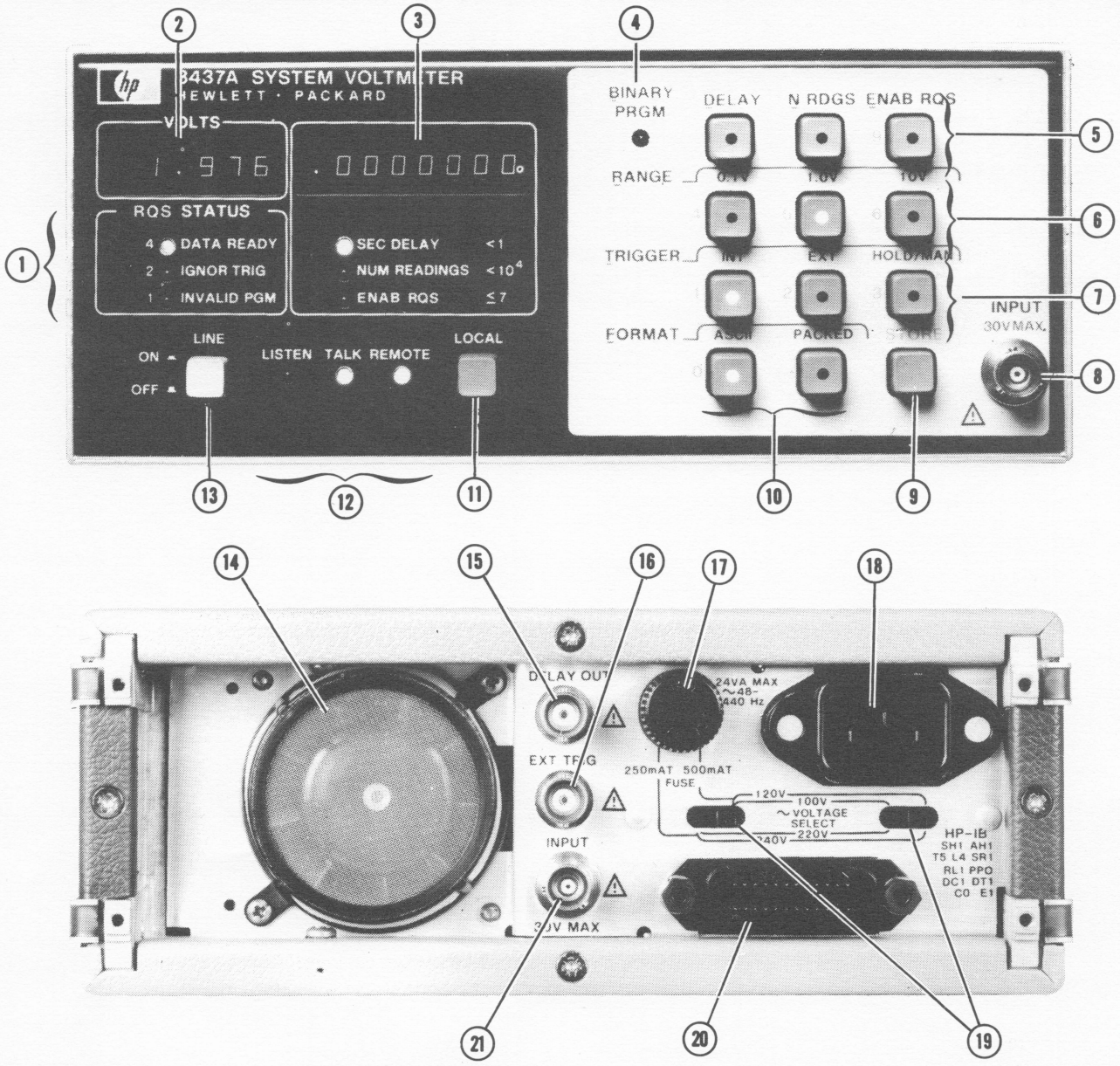
b. NRDGS (0–9999). A decimal point entry into the number of readings field results in an invalid program condition. When this occurs, the last valid NRDGS entry is stored and the numeric entry mode is terminated. The INVALID PGM annunciator remains on until the key causing the invalid entry is released.

c. ENAB RQS (0–7). Any entry other than 0–7 results in an invalid program condition. When this occurs, the last valid ENAB RQS entry is stored and the numeric entry mode is terminated. The INVALID PGM annunciator remains on until the key causing the invalid entry is released.

d. STORE. If the STORE key is pressed while the keyboard is not in the Numeric Entry mode, an invalid program condition occurs. The INVALID PGM annunciator remains on until the key causing the invalid entry is released.

REMOTE:

An invalid entry while in the Numeric Entry mode, or the use of an invalid program code, will result in an invalid



1 Annunciated instrument status (service request [SRQ] will be set if RQS STATUS and ENAB RQS [numeric entry display] correspond).

2 Volts display - Displays the sign and magnitude of the sampled input voltage.

3 Numeric entry display - Displays DELAY, NRDGS, and ENAB RQS entries.

4 Binary program mode annunciator.

5 Pre-entry keys for DELAY, NRDGS (Number of readings), and ENAB RQS (request service mask).

6 Voltage range select keys

7 Trigger mode select keys

8 Input connector

9 Numeric entry termination key (stores contents of the numeric entry display).

10 Output data format select keys

11 Keyboard return-to-local

12 Annunciated HP-IB status

13 Line switch

14 Fan

15 Delayed trigger output connector

16 External trigger input connector

17 Fuse

18 Line cord receptacle

19 Line voltage select switch

20 HP-IB connector

21 Input connector

Figure 3-1. 3437A Front and Rear Panel Description.

program condition to occur. The INVALID PGM annunciator remains on until the 3437A is readdressed to listen.

3-15. DELAY 7 . The DELAY key (delay pre-entry) is used when entering either the delay between readings (NRDGS > 1) or the delay that occurs prior to sampling the input voltage after the 3437A is triggered (NRDGS=1).

EXAMPLE:

1. Press DELAY 7
   a. The Numeric Entry mode is annunciated by the (Flashing) DELAY annunciator.
   b. The numeric entry display (annunciated by SEC DELAY) displays the previously stored delay.
2. Press . (Any entry other than a decimal point (leading zeros ignored) results in an invalid program condition.
3. Enter up to 7 integers corresponding to the specified delay (additional inputs are ignored). A partial delay field can be set to zeros by pressing STORE .
4. Terminate DELAY entry (Numeric Entry mode) by pressing STORE

3-16. N RDGS 8 The NRDGS key (number of readings pre-entry) is used when entering the number of readings to be taken after the 3437A is triggered.

EXAMPLE:

1. Press N RDGS 8
   a. The Numeric Entry mode is annunciated by the (Flashing) NRDGS annunciator.
   b. The numeric entry display (annunciated by NUM READINGS) displays the previously stored number of readings.
2. Enter a 4 digit integer (0–9999) corresponding to the number of readings to be taken after the 3437A is triggered. (If a decimal point is entered into the number of readings field, an invalid program condition results.) Additional entries into a completed NRDGS field, cause previous entries to be shifted left.
3. Terminate NRDGS entry (Numeric Entry mode) by pressing STORE

3-17. ENAB RQS 9 . The ENAB RQS key (enable request pre-entry) is used when entering the request service mask. (The request service mask is an octal number (0-7) identifying the conditions for which service request (SRQ) is initiated.) Table 3-1 shows the request service mask and corresponding conditions for which the 3437A will initiate a service request.

EXAMPLE:

1. Press ENAB RQS 9
   a. The Numeric Entry mode is annunciated by the (Flashing) ENAB RQS annunciator.
   b. The numeric entry display (annunciated by ENAB RQS) displays the previously stored request service mask.
2. Enter the request service mask (0-7). An invalid entry results in an invalid program condition to occur. (Additional entries override previous entries.)
3. Terminate ENAB RQS entry (numeric entry mode) by pressing STORE .

Table 3-1. SRQ Conditions.

RQS Mask[1]		Conditions for Initiating SRQ
(4 2 1)	(Octal)	
0 0 0	0	No SRQ Capabilities
0 0 1	1	Invalid Program
0 1 0	2	Trigger Ignore
0 1 1	3	Trigger Ignore or Invalid Program
1 0 0	4	Data Ready
1 0 1	5	Data Ready or Invalid Program
1 1 0	6	Data Ready or Trigger Ignore
1 1 1	7	Data Ready or Trigger Ignore or Invalid Program

[1] a. Invalid PGM
b. Trig Ignore
c. Data Ready

3-18. RANGE 0.1V 4 1.0V 5 10V 6 The three voltage ranges (annunciated by the range select keys) are selected by pressing either the 0.1V 4 1.0V 5 10V 6 key. (Each range has 100% overrange capability.) The displayed decimal point position will not correspond to the selected voltage range until the 3437A has sampled the input voltage.

INT.

a. Local - With zero delay programmed, the sample rate is approximately 10 samples per second.

b. Remote - To generate an internal trigger while in remote, the following conditions must exist:

1. Remote
2. Internal Trigger
3. Addressed to Talk
4. Not in Binary Prgm Mode
5. Not in Serial Poll Mode
6. Not in Numeric Entry Mode

With these conditions satisfied, the 3437A will generate an internal trigger on the transition of ATN false.

EXT.

The 3437A will sample the input voltage when triggered (TTL negative edge) at the external trigger input connector.

CAUTION

External trigger inputs exceeding TTL levels (0 to 5 V) may cause damage to the 3437A's external trigger input circuitry. The Performance Test trigger interface (-hp- 34113A) is usefull for clamping bipolar triggers to within TTL levels. Refer to page 5-85 for more information on this interface.

HOLD/MAN. (LOCAL & REMOTE)

The first time the HOLD/MAN 3 key is pressed, the 3437A holds the volts display of the last sampled voltage constant. The second time the HOLD/MAN 3 key is pressed (and each time thereafter), a manual trigger is generated. Manual triggers can be generated in this manner until a new function is programmed.

GROUP EXECUTE TRIGGER.

(Addressed HP-IB Command.) Each time the 3437A receives group execute trigger (GET) while addressed to listen, it will generate a trigger (regardless of trigger mode selected).

3-20. FORMAT ASCII 0 . PACKED The output data format is selectable between an ASCII (8-byte) and PACKED (2-byte) format.

3-21. ASCII 0 . Each data transfer is output as 6 ASCII characters, followed by a carriage return (CR) and line feed (LF) concurrent with EOI true.

EXAMPLES:

a. **Normal**

i.	.1 volt range	± .1998 (CR)	(LF and EOI)
ii.	1 volt range	± 1.998 (CR)	(LF and EOI)
iii.	10 volt range	± 19.98 (CR)	(LF and EOI)

b. **Overload**

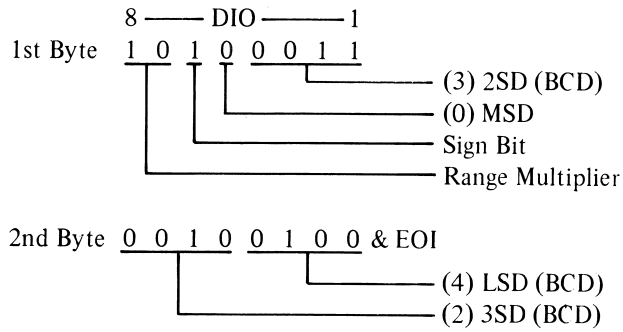
i.	.1 volt range	± .9999 (CR)	(LF and EOI)
ii.	1 volt range	± 9.999 (CR)	(LF and EOI)
iii.	10 volt range	± 99.99 (CR)	(LF and EOI)

For measurement data where NRDGS > 1, the (CR) and (LF and EOI) is suppressed (between the intermediate outputs) and the data is delimited by a comma.

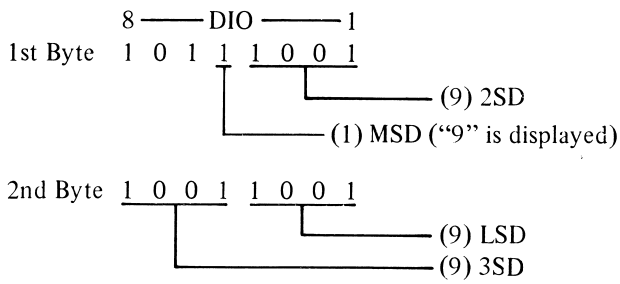
3-22. PACKED . Each data transfer is output as 2 binary bytes. The second byte is concurrent with EOI true.

EXAMPLES:

a. **Normal** (+ 3.24 volts, 10 volt range)



b. **Overload** (+25 volts, 10 volt range)



For measurement data where NRDGS > 1, EOI is suppressed (between intermediate outputs) and the data is not delimited. EOI true is sent concurrent with the second data-byte of the last data transfer. Table 3-2 shows the packed format designators.

3-23. LOCAL. When the 3437A is in remote (not local lockout), pressing LOCAL returns the 3437A keyboard from remote (HP-IB controlled) to local (front panel controlled).

3-24. Programming Instructions.

3-25. The 3437A is a systems instrument intended to be used with the HP-IB (IEEE STD 488-1975 or equivalent) system. The following paragraphs describe HP-IB operation.

Table 3-2. Packed Format Designators.

Byte	Function	DIO 8	7	6	5	4	3	2	1	Description
1st	Range Multiplier	0	1							1 Volt Range
		1	1							1 Volt Range
		1	0							10 Volt Range
	Sign bit			1						Positive
				0						Negative
	MSD				1					)
					0					Numeric
	2 SD					X	X	X	X	Value of Sampled
2nd	3 SD	X	X	X	X					Input Voltage
	LSD					X	X	X	X	)

3-26. The HP-IB transfers messages (data and commands) between the components of an instrumentation system on 16 signal lines. The interface functions for each system component are performed within the component so that only passive cabling is needed to connect the system. The cables connect all instruments, controllers, and other components of the system in parallel.

3-27. Eight of the lines (DIO 1-8) are reserved for the transfer of messages in a byte-serial, bit-parallel manner. Message transfer is asynchronous, coordinated by the three handshake lines (DAV, NRFD, and NDAC). The remaining five lines are for control of HP-IB activity.

3-28. Devices connected to the HP-IB may be talkers, listeners, or controllers. The controller dictates the roll of each of the other devices by setting the ATN (attention) line true and sending talk or listen addresses on the data lines (DIO 1-8).

3-29. Addresses are set into each device at the time of system configuration. (The 3437A HP-IB address select switch is located on the Logic board.) While the ATN line is true, all devices must listen to the data lines. When ATN is false, only devices that have been addressed will actively send or receive data. All other devices ignore the data lines.

3-30. Several listeners can be active simultaneously but only one talker can be active at a time. Whenever a talk address is put on the data lines (while ATN is true), all other talkers are automatically unaddressed.

3-31. Information is transmitted on the data lines under sequential control of the three handshake lines. No step in the sequence can be initiated until the previous step is completed. Information transfer can proceed as fast as devices can respond, but no faster than allowed by the slowest device presently addressed. This permits several devices to receive the same message byte concurrently.

3-32. The ATN line is one of the five control lines. When ATN is true, addresses and commands are transmitted on seven of the data lines using the ASCII code. When ATN is false, any code of 8 bits (or less) understood by both talker and listener(s) may be used.

3-33. The other control lines are IFC, REN, SRQ, and EOI. IFC (interface clear) places the interface system in a known quiescent state (the 3437A becomes unaddressed to listen, unaddressed to talk, and the serial poll mode (SPM) is cleared). REN (remote enable) is used in conjunction with listen addresses to select either local or remote control of each device. Any device having service request capability can set service request (SRQ) true. This indicates to the system controller that a device on the bus requires attention. EOI (end or identify) is used by a device to indicate the end of a multiple-byte transfer (the 3437A sets EOI true concurrent with the last data-byte of a multiple data-byte transfer). For further information concerning the HP-IB, refer to "Hewlett-Packard Interface. A Compendium of Technical Articles" -hp- publications No. 5952-2472.

3-34. HP-IB Address Selection. A seven-bit binary code forms the complete TALK or LISTEN address of the 3437A. The first five bits of the code (selected by A2S1) are referred to as the instrument address. The remaining two bits (DIO 6-7) are controller originated and define the address to be either TALK or LISTEN. The seven-bit code forms as ASCII character (Table 3-3) that uniquely defines the selected TALK or LISTEN address. Figure 3-2 illustrates the address select switch and address code designators.

3-35. Program Code Set. Program code (an alpha-numeric code representing various instrument functions) is used to control the front panel while the 3437A is in the remote mode of operation. To implement the program code set (Table 3-4), it is necessary for the 3437A to be in remote and addressed to listen.

3-36. The 3437A front panel is designed to imply the program code set. The underlined alpha characters represent the program code alpha symbol for the corresponding instrument function.

EXAMPLE:

The program code string:

D.0025S, N100S, E0S, R3, T2, F1 reads:

1.	DELAY	2.5 ms
2.	NRDGS	100
3.	ENAB RQS	0
4.	Range	10 Volts
5.	Trigger	External
6.	Format	ASCII

It is not necessary to reprogram all functions each time a programming change is made. (The order of program code, and the use of commas is optional.)

Table 3-3. Address Codes.

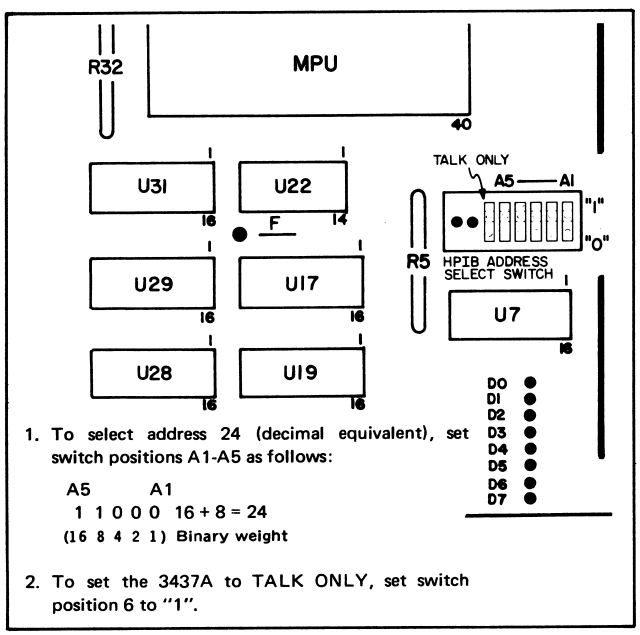
ASCII CODE CHARACTER		BINARY CODE						OCTAL CODE		5 BIT DECIMAL[3] EQUIVALENT
Listen Address	Talk Address	b_7[1]	b_6	A5 b_5	A4 b_4	A3 b_3	A2 b_2	A1 b_1	Listen	Talk	
SP	@			0	0	0	0	0	040	100	0
!	A			0	0	0	0	1	041	101	1
"	B			0	0	0	1	0	042	102	2
#	C			0	0	0	1	1	043	103	3
$	D			0	0	1	0	0	044	104	4
%	E			0	0	1	0	1	045	105	5
&	F			0	0	1	1	0	046	106	6
'	G			0	0	1	1	1	047	107	7
(	H			0	1	0	0	0	050	110	8
)	I			0	1	0	0	1	051	111	9
*	J			0	1	0	1	0	052	112	10
+	K			0	1	0	1	1	053	113	11
,	L			0	1	1	0	0	054	114	12
-	M			0	1	1	0	1	055	115	13
.	N			0	1	1	1	0	056	116	14
/	O			0	1	1	1	1	057	117	15
0	P			1	0	0	0	0	060	120	16
1	Q			1	0	0	0	1	061	121	17
2	R			1	0	0	1	0	062	122	18
3	S			1	0	0	1	1	063	123	19
4	T			1	0	1	0	0	064	124	20
5	U			1	0	1	0	1	065	125	21
6	V			1	0	1	1	0	066	126	22
7	W			1	0	1	1	1	067	127	23
8	X			1	1	0	0	0	070	130	24[2]
9	Y			1	1	0	0	1	071	131	25
:	Z			1	1	0	1	0	072	132	26
;	[			1	1	0	1	1	073	133	27
<	\			1	1	1	0	0	074	134	28
=	]			1	1	1	0	1	075	135	29
>	~			1	1	1	1	0	076	136	30

[1]Only the first five bits of the binary code are listed. These bits (set by A2S1) are the same for both the TALK and LISTEN address. The sixth and seventh bits (controller originated) determine whether the instrument is being addressed to TALK or LISTEN.

Function	Bit 7	Bit 6
Talk	1	0
Listen	0	1

[2]3437A factory preset address.

[3]Derived from the sum of the binary weighted value of the first five address bits.



1. To select address 24 (decimal equivalent), set switch positions A1-A5 as follows:

   A5 A1
   1 1 0 0 0 16 + 8 = 24
   (16 8 4 2 1) Binary weight

2. To set the 3437A to TALK ONLY, set switch position 6 to "1".

Figure 3-2. Address Select Switch and Address Code Designators.

Table 3-4. 3437A Program Code Summary.

PROGRAMMING CODES[1]		
Program Code (ASCII Character)	Description	Octal Code
D	Delay	104
N	NRDGS	116
E	ENAB RQS	105
S	Store	123
R	Range	122
1	.1 volt	061
2	1 volt	062
3	10 volts	063
T	Trigger	124
1	Internal	061
2	External	062
3	Hold/Man	063
F	Format	106
1	ASCII	061
2	Packed	062
B	Binary Prgm	102

[1]Program Code Handshake occurs with the 3437A in Remote, Addressed to Listen, and ATN false.

3-37. Message Set. Bi-directional traffic over the HP-IB (including program code) is described in terms of messages.

The controller originated messages (commands) are described in Table 3-5 and catagorized as follows:

1. Addressed (Directed to bus devices previously addressed to listen)
2. Universal (Directed to all bus devices capable of responding to the command)

EXAMPLE:

The system controller can configure the 3437A to its initial turn-on state by sending the universal command, Device Clear (DCL), or the addressed command, Selected Device Clear (SDC).

3-38. The 3437A originated messages allow the 3437A to communicate with the system controller, and to participate in the handshake process involved in the data-byte transfer process.

EXAMPLE:

The 3437A can advise the system controller that it requires service by sending the service request (SRQ) message.

Table 3-5. 3437A Message Set Summary Sheet.

Messag	Description	Class	Octal Code	R E N	I F C	Instrument Response
DCL	Device Clear	UC[2]	024	T		The 3437A configures to its initial turn-on state. Volts display (sampled input voltage) Numeric entry display (SEC DELAY) RQS STATUS (DATA READY) DELAY (0) NRDGS (1) ENAB RQS (0) RANGE (10 volts) TRIGGER (INT) FORMAT (ASCII)
SDC	Selected Device Clear	AC[3]	004			If addressed, the 3437A configures to its turn-on state.
GET	Group Execute Trigger	AC	010	T		Is triggered (regardless of trigger mode)
GTL	Go to Local	AC	001	T		Returns the 3437A from remote (HP-IB Controlled) to local (front panel controlled)
LLO	Local lockout	UC	021	T		Disables the Local Key From LLO to GTL to TREN = Remains in LLO From LLO to FREN to TREN = Exits LLO
MLA	My Listen Address	AC				Becomes addressed to listen.
MTA	My Talk Address	AC				Becomes addressed to talk.
UNL	Unlisten	AC	077			Becomes unaddressed to listen.
UNT	Untalk	AC	137			Becomes unaddressed to talk.
SPE	Serial Poll Enable	UC	030			Configures the 3437A into the serial poll mode.
SPD	Serial Poll Disable	UC	031			Exits serial poll mode.
IFC	Interface Clear	}	Single Line MSG		T	Unaddress the 3437A as a talker and as a listener and clears serial poll mode.
REN	Remote Enable	}	Single Line MSG	T		Programs the 3437A to remote (concurrent with MLA).
		}	Single Line MSG	F		Returns the 3437A to local.

[1]All multiline (DIO 1-8) messages are sent with ATN true.
[2]Universal command.
[3]Addressed command.

3-39. The capability of the 3437A as a systems instrument (in accordance with IEEE - 488-1975) is as follows:

SH1	Source	RL1	Remote/Local
AH1	Acceptor	PP0	Parallel Poll
T5	Talker	DC1	Device Clear
L4	Listener	DT1	Device Trigger
SR1	Service Request	C0	Controller

3-40. Binary Program.

3-41. Binary Programming, consisting of a learn mode (3437A to controller) and a program mode (controller to 3437A) provides the following programming capabilities.

3-42. Learn. The learn mode allows the system controller to determine (learn) the programmed state of the 3437A. When interrogated in the learn mode, the 3437A responds by handshaking 7 bytes (completely describing the programmed state of the instrument) onto the HP-IB. The controller, aware of the programmed state of the instrument, identifies the 7 bytes with this programmed state (Table 3-6).

3-43. Program. The program mode allows the system controller to program the 3437A using an abreviated program code (identical 7 bytes received in the learn mode). Since an abbreviated program code is used (compared to the normal ASCII string of up to 25 bytes to accomplish the same function), the 3437A can be reprogrammed in a minimum amount of time.

3-44. The following example illustrates Binary Program mode operation.

EXAMPLE:

1. The 3437A is preset as follows:

DELAY	500 μs
NRDGS	9999
ENAB RQS	2
RANGE	10 Volt
TRIGGER	External
FORMAT	ASCII

Table 3-6. Binary Program Code Designators.

Byte	Function	DIO 8	7	6	5	4	3	2	1	Description
1	Range							0	0	Invalid
								0	1	.1 Volt
								1	0	10 Volt
								1	1	1 Volt
	Trigger					0	0			Invalid
						0	1			Internal
						1	0			External
						1	1			Hold/Man
			(4	2	1)					
	ENAB RQS		0	0	0					Does not request service
			0	0	1					Invalid Prgm
			0	1	0					Ignore Trig
			0	1	1					Invalid Prgm/Ignore Trig
			1	0	0					Data Ready
			1	0	1					Data Ready/Invalid Prgm
			1	1	0					Data Ready/Ignore Trig
			1	1	1					Data Ready/Ignore Trig/Invalid Prgm
	Data Format	0								Packed
		1								ASCII
		(8	4	2	1)					
2	NRDGS	X	X	X	X					MSD
						X	X	X	X	2SD
3		X	X	X	X					3SD
						X	X	X	X	LSD
4	Delay	X	X	X	X					Not Used (May or may not be set)
						X	X	X	X	MSD
5	Delay	X	X	X	X					2SD
						X	X	X	X	3SD
6	Delay	X	X	X	X					4SD
						X	X	X	X	5SD
7	Delay	X	X	X	X					6SD
						X	X	X	X	LSD

2. The system controller programs the 3437A to the Binary Program mode.

   - The 3437A is addressed to listen.
   - The controller handshakes the ASCII character B (102_8) into the 3437A. The Binary Program annunciator is illuminated.

3. The system controller interrogates the 3437A, and the 3437A responds by handshaking 7 bytes (completely describing the programmed state of the instrument) onto the HP-IB (Table 3-7).

   - The 3437A is addressed to talk.
   - When ATN becomes false, the 3437A outputs the 7 bytes onto the HP-IB.
   - The 3437A terminates the Binary Program mode after the 7th byte is output onto the HP-IB.

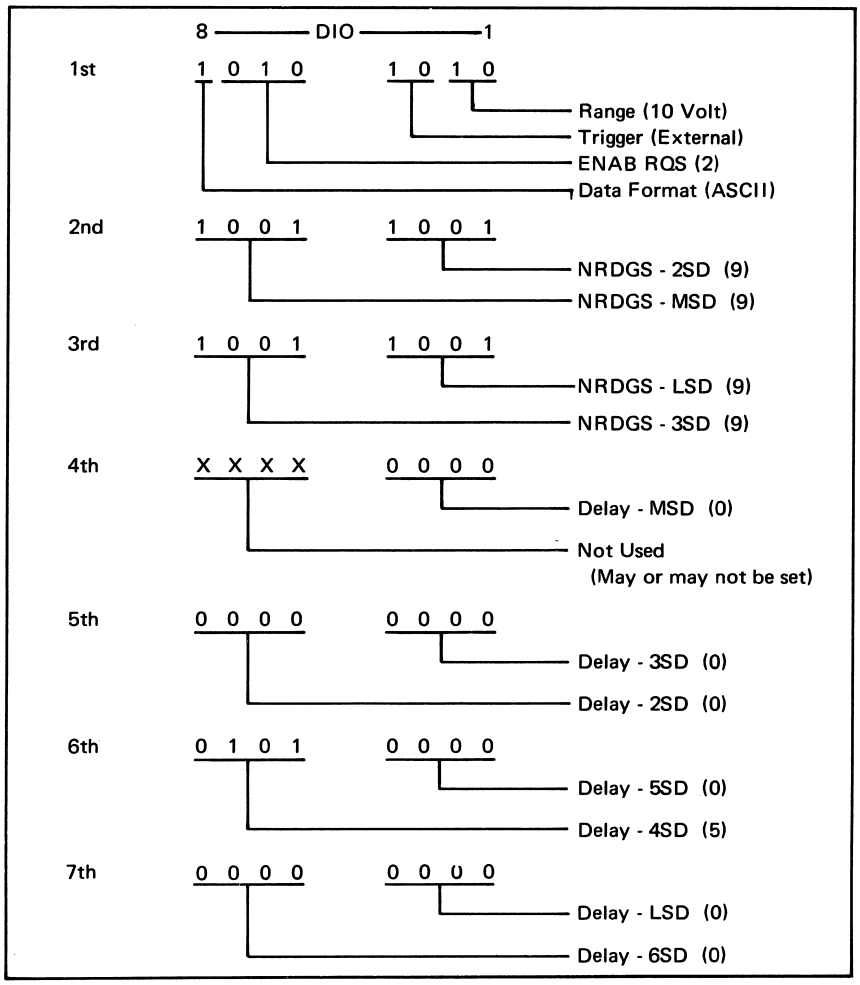
4. The controller stores the 7 bytes, then when required, reprograms the 3437A using the identical 7 bytes. The 3437A responds by reconfiguring to its previous state.

   - The 3437A is addressed to listen.
   - The controller handshakes the ASCII character B (102_8) into the 3437A. The Binary Program mode annunciator is illuminated.
   - The controller handshakes the 7 bytes into the 3437A, reconfiguring the instrument to its previous state.
   - The 3437A terminates the Binary Program mode after the 3437A handshakes the 7th byte.

3-45. Service Request.

3-46. The following events describe the process involving service request (SRQ), serial poll enable (SPE), and serial poll disable (SPD).

Table 3-7. Binary Program Byte Sequence (Example).



a. The 3437A operator defines and programs the service request mask (ENAB RQS).

b. The 3437A sets SRQ true when ENAB RQS (0 - 7) and RQS STATUS (0 - 7) correspond.

c. The controller, programmed to respond to a service request, sets SPE true and conducts a serial poll. When the 3437A is in the serial poll mode and is addressed to talk, the 3437A responds by writing a serial poll status byte onto the HP-IB (Table 3-8).

When the serial poll status byte is output onto the HP-IB, the 3437A clears SRQ.

d. The controller clears SPE by sending SPD.

Table 3-8. Serial Poll Status Byte.

Function	DIO 8	7	6	5	4	3	2	1	Description
ENAB RQS						X	X	X	Binary Code (0-7)[1]
RQS STATUS			X	X	X				Binary Code (0-7)
RQS Bit		X							Identifies the 3437A as the instrument that set SRQ True. (1 α True and 0 α False)
Not Used	X								Don't care.

[1]See Table 3-6.

3-47. APPLICATIONS.

3-48. Introduction.

3-49. The 3437A, although designed as a System DVM, is capable of performing numerous bench (stand-alone) as well as systems functions. The following paragraphs describe some 3437A bench applications.

3-50. Bench Measurements.

3-51. Variable Sample-Rate DVM.

a. The 3437A can be programmed to sample voltages at rates of 100 ms to 1 second. Program the 3437A keyboard as follows:

DELAY. . . . . 100 ms to .9999999 second
NRDGS. 1
RANGE. . . . . As required
TRIGGER . . . . . INT

b. The 3437A will sample (and display) the instantaneous value of the input voltage at a rate specified by the programmed delay.

3-52. Time-Selective DVM.

3-53. Oscilloscope Accuracy Enhancement. Oscilloscope measurement accuracy can be enhanced to equal the voltage and delay accuracy of the 3437A. The technique requires that the oscilloscope main gate output (corresponding to start of sweep) externally trigger the 3437A, and that the 3437A Delay out modulate the oscilloscope Z-axis (video) input. The voltage to be measured is connected to both the oscilloscope and 3437A inputs. Each time the oscilloscope is triggered, the oscilloscope main gate output triggers the 3437A, and depending upon the programmed delay, the 3437A samples the input voltage sometime between reoccuring sweeps. Each time the 3437A samples the input voltage, the Delay out (connected to the oscilloscope Z-axis input) is forced low and intensifies the oscilloscope display for the time required to perform the conversion sequence.

3-54. The user views the oscilloscope display, then programs the 3437A delay to intensify the point of interest. The amplitude of the waveform and the lapsed time (from start of sweep to the leading edge of the intensified section) is displayed by the 3437A Volts and Numeric entry displays.

Example:

a. Connect the equipment as illustrated in Figure 3-2.

b. Program the 3437A keyboard as follows:

DELAY. . . . . 3 ms
NRDGS. 1
RANGE. 10
TRIGGER . . . . . EXT

c. Set the 3310A controls as follows:

FUNCTION . . . . . SQ
RANGE. 10
DIAL 25
DC OFFSET. . . . . OFF
OUTPUT LEVEL . . . . . MIN

d. Set the oscilloscope controls as follows:

TIME/DIV. . . . . 1 ms
VOLTS/DIV. 1
TRIGGER . . . . . INTERNAL

e. Adjust the 3310A output level, and the oscilloscope trigger and intensity levels to obtain a waveform as illustrated in Figure 3-3.

f. Program the 3437A Delay so that the intensified section appears at the point of interest then read the corresponding magnitude and delay displayed by the Volts and Numeric entry display.

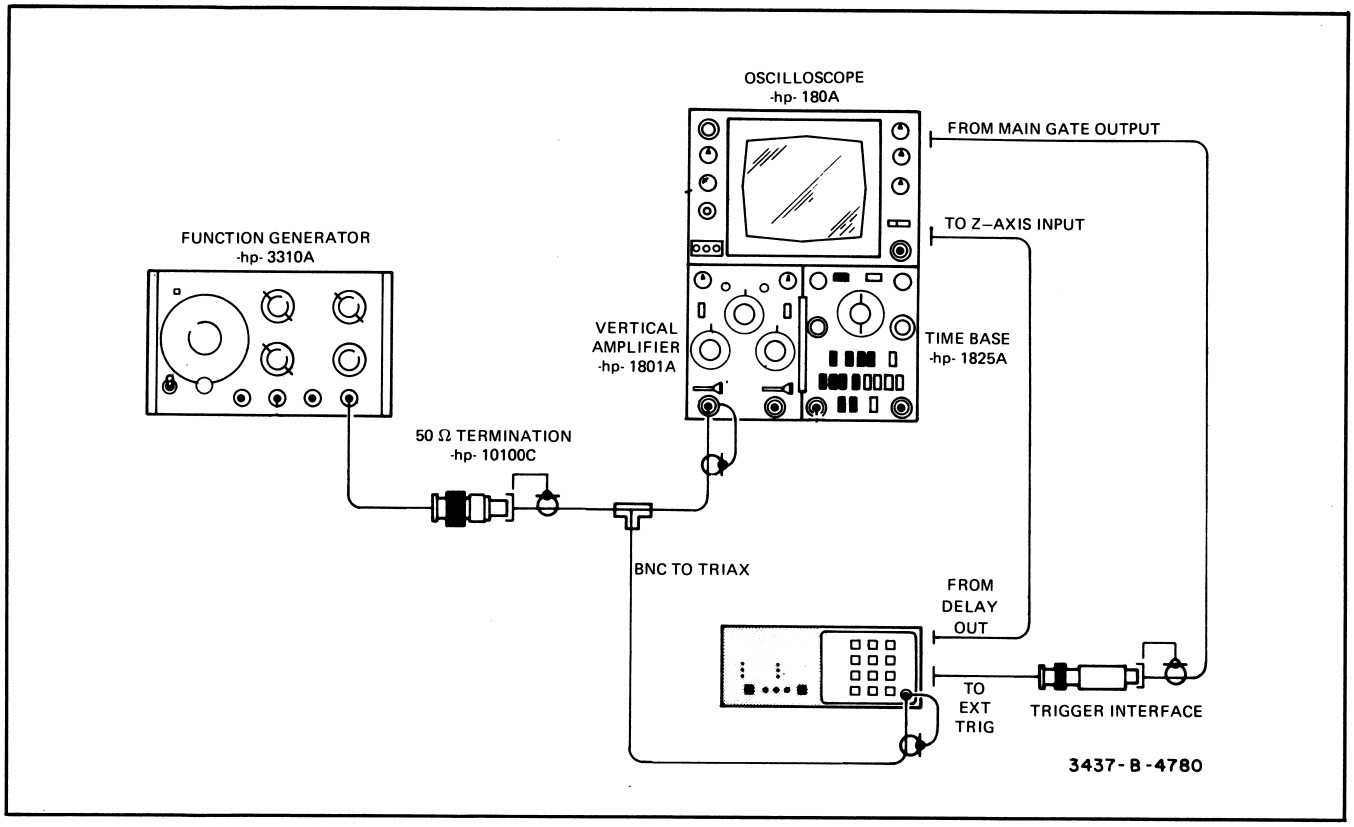


Figure 3-2. Oscilloscope Accuracy Enhancement.

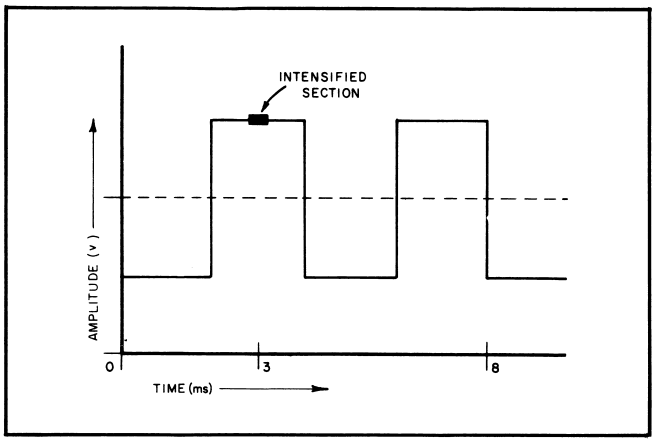


Figure 3-3. Intensified Waveform.

3-55. Delay Generator.

3-56. The 3437A can be programmed to delay an external trigger from 0 to .9999999 sec in 100 ns steps.

Example:

a. Connect the equipment as illustrated in Figure 3-4.

b. Program the 3437A keyboard as follows:

DELAY. . . . . 800 ns
NRDGS. 0
RANGE. . . . . –
TRIGGER . . . . . EXT

c. Set the 3310A controls as follows:

FUNCTION . . . . . .SQ
RANGE. 100
DIAL 10
DC OFFSET. . . . . OFF
OUTPUT
LEVEL. . . . . MINIMUM

d. Set the oscilloscope controls as follows:

TIME/DIV . . . . . 100 μs
VOLTS/DIV (A/B) 5/DC
TRIGGER . . . . . EXTERNAL

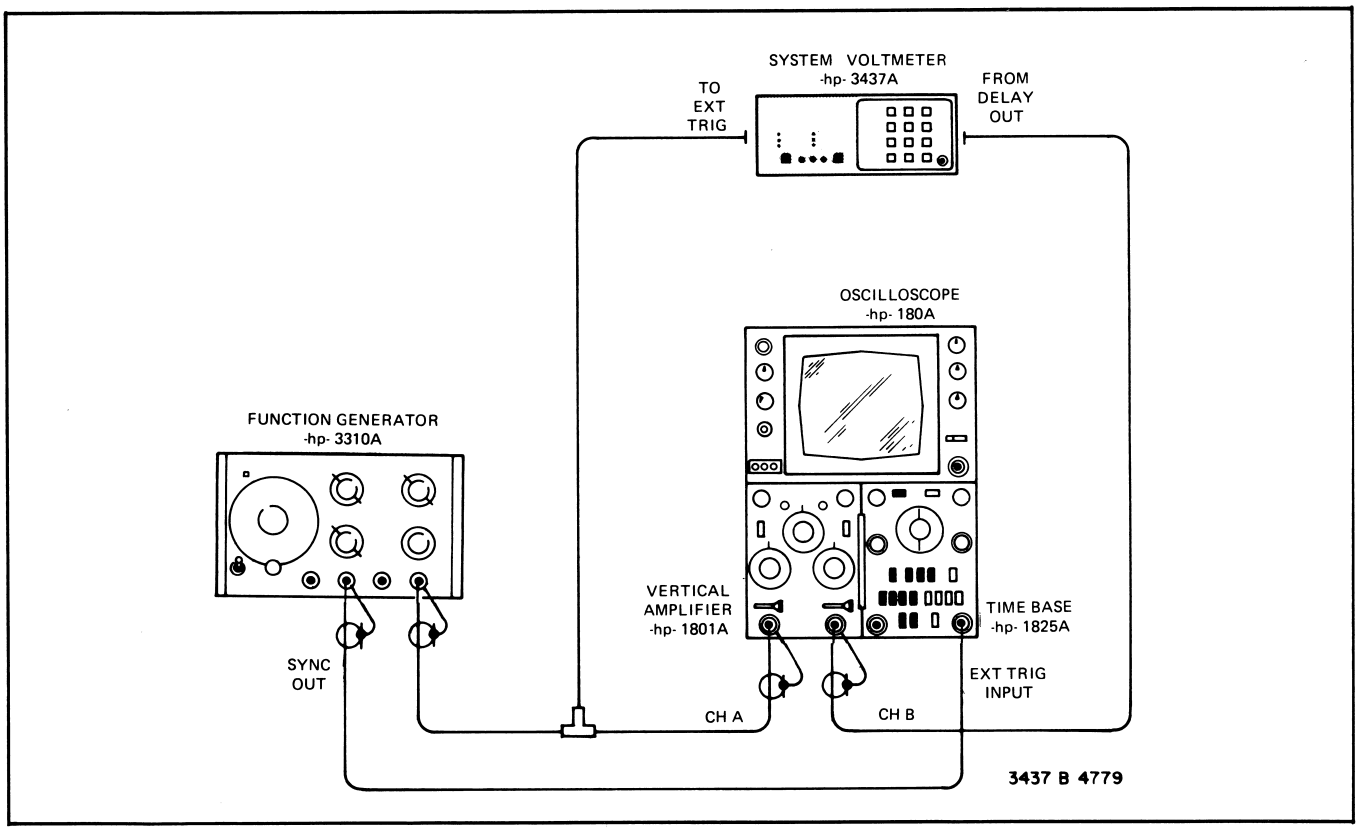


Figure 3-4. Delay Generator.

e. Adjust the 3310A output level and oscilloscope trigger level to obtain a display as illustrated in Figure 3-5. (Assure that the 3310A output is of sufficient amplitude to trigger the 3437A.)

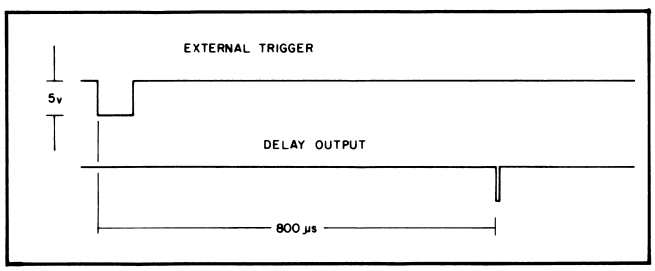


Figure 3-5. Delayed Output.

3-57. Trigger Generator.

3-58. The 3437A can be programmed to function as a trigger generator or as a burst trigger generator (up to 9999 triggers per burst).

3-59. Trigger Generator. Program the 3437A keyboard as follows:

DELAY. 0
NRDGS. 1
TRIGGER . . . . . .INT

a. The Delay out waveform is illustrated in Figure 3-6.

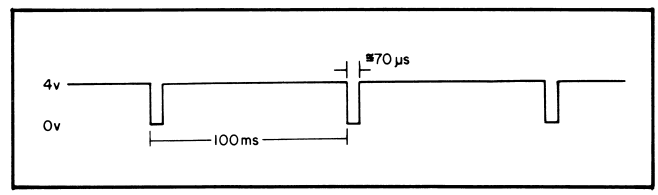


Figure 3-6. Delay Out Waveform.

b. The 3437A Delay can be programmed from 0 to .9999999 second (100 ns step) to provide continuous triggers at rates from 10 Hz to 1 Hz.

3-60. Burst Trigger Generator. Program the 3437A keyboard as follows:

DELAY. . . . . 500 µs
NRDGS. 5000
TRIGGER . . . . . EXT/INT

a. For each trigger received, the 3437A will generate a burst of triggers (5000) at a 2000 Hz (1/500 µs) rate (Figure 3-7). Maximum Rate = 9 kHz.

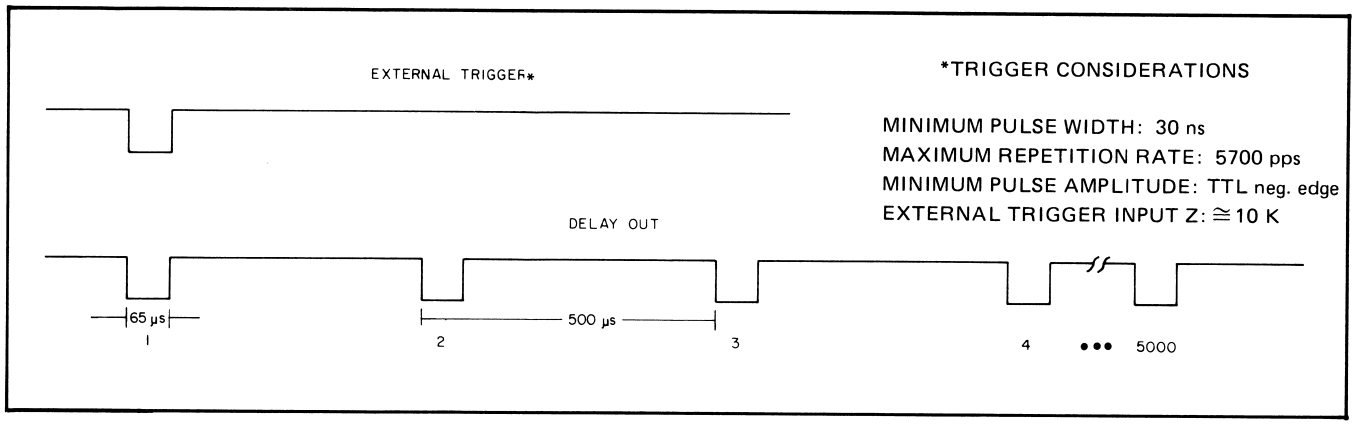


Figure 3-7. Burst Mode Delay Out.

3-61. System Measurements.

Systems Applications include:

- Waveform Analysis
  - Harmonic Content
  - Amplitude Characteristics
- Low Frequency True RMS Measurements
- Transient Characterization

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